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The effect of local anaesthetic agents on opioid use and recovery in patients undergoing open heart surgery: a randomized controlled study

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Abstract

Background After open heart surgery, patients experience high levels of pain at the sternotomy incision site and around the chest tube(s), affecting their recovery. This study was conducted to determine the effects of local anesthetic application around the sternotomy incision site and chest tube(s) on the amount of opioids used and recovery after surgery in patients undergoing open heart surgery.

Methods This randomized controlled experimental study was conducted with a total of 60 patients, with 30 patients in the experimental group and 30 patients in the control group. In the experimental group, LIDOFAST 40 mg/2 ml + 0.025 mg/2 ml, a local anesthetic agent, was applied to the postoperative sternotomy incision site and around the chest tube(s) in addition to routine treatment. Patients in the control group received only routine treatment. Data were collected using the "Descriptive Characteristics Form" and the "Postoperative Recovery Index".

Results It was observed that postoperative pain started later, opioid consumption decreased, and postoperative recovery was faster in the experimental group. As the number of chest tubes increased, recovery was delayed in all groups, and as the number of opioids used increased, postoperative recovery was negatively affected in the control group.

Conclusions In this study, local anesthetic application to the sternotomy incision site and around the chest tubes after open heart surgery was found to reduce postoperative opioid consumption and positively affect recovery.

Trial registration Current Controlled Trials NCT06642077 (Retrospectively registered).

Keywords Cardiovascular surgery, Pain management, Local anesthetics, Recovery after surgery, Opioids

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Background

Despite the increase in life expectancy and advances in disease prevention, medical diagnosis, and treatment methods, cardiovascular diseases are still among the major life-threatening diseases. In 2019, 18.6 million people reportedly died from cardiovascular diseases, making it one of the most common fatal diseases [1].Today, open heart surgery is the most commonly used method in the treatment of heart diseases [2, 3]. Open-heart surgery is a technically successful treatment method, but it also has many complications. One of the most common complications after open-heart surgery is pain. Pain is a concern for postoperative patients, and the most severe pain is experienced in the first 24 h after open heart surgery [4, 5]. Since pain begins during the intensive care process of patients, the knowledge of intensive care nurses about pain diagnosis, cause, type, duration, severity, consequences, possible complications, pain assessment, and pain management plays a crucial role in the patient care process and constitutes the core of quality care [6]. Postoperative pain is caused by intraoperative damage to tissues and organs, inflammation at the surgical incision site, use of chest and mediastinal tubes, and prolonged sternal retraction [4, 7]. Pain after open heart surgery is referred to as acute pain and is described by the patient as burning and throbbing at the sternotomy incision site [8, 9].

The standard pharmacologic treatment for pain relief after open heart surgery is the use of opioid and non-opioid analgesics. The combined use of opioid derivatives and paracetamol drugs in the management of acute pain after cardiac surgery is one of the most commonly used treatment options [10]. However, it is included in evidence-based guidelines that opioids have side effects such as respiratory depression, euphoria, vasodilation, bradycardia, myosis, nausea and vomiting, somnolence, skeletal muscle rigidity, smooth muscle spasm and related constipation, urinary retention, biliary spasm, tolerance development, and physical dependence while providing analgesic effects, and there are specific interventions for these side effects [11, 12]. For this reason, the use of these drugs should be very careful in the postoperative period. Different pain relief methods used in the postoperative period may be preferred instead of opioids. Local anesthetic agents applied to painful areas after surgery are effective pain relief methods and reduce the need for opioid use by patients [13].

Local anesthetics are adjuvant analgesics that block sodium channels, preventing unexpected impulses from impaired nerves. When administered locally rather than systemically, these drugs have a much stronger analgesic effect. Local anesthetics can be applied clinically in a variety of ways to manage acute or chronic pain [14]. Local anesthetics are also a good option for postoperative pain management. This method, which has no effect on mortality and morbidity rates, effectively improves postoperative pain management and reduces the amount of opioid use [13, 14]. The aim of this study was to investigate the effect of LIDOFAST 40 mg/2 mL + 0.025 mg/2 mL local anesthetic drug on pain management when applied to the sternotomy incision area and around the chest tube(s), which is the most common place where patients feel pain after open heart surgery, to what extent it affects the amount of opioid consumption after surgery, and how this intervention affects the recovery process of patients after surgery.

The hypotheses of this study are as follows:

H0 In patients undergoing open heart surgery, local anesthetic application around the sternotomy incision site and chest tube(s) has no effect on the amount of postoperative opioid use and recovery.

H1 In patients undergoing open heart surgery, local anesthetic application around the sternotomy incision site and chest tube(s) has an effect on the amount of postoperative opioid use and recovery.

Methods

Design

This study was conducted as a randomized controlled experimental study.

Setting and sample

The study population consisted of patients who underwent open heart surgery in the Cardiovascular Surgery Intensive Care Unit of a hospital. The sample group consisted of patients who met the inclusion criteria (18–65 years old, conscious, willing to communicate and cooperate after open heart surgery).

For the planned study, the "G. Power-3.1.9.2" program was used to calculate the sample size at an 80% confidence level prior to data collection. The sample was determined with the "Sample Calculation Formula (n = Nz2pq / d2(N-1) + z2pq). According to the literature review, it was determined that the "effect size value was 0.096". Accordingly, with a primary type error of 5% (Z = 1.96), a test power of 80%, and an effect size of 0.096 units, the minimum sample size was calculated as n = 60. Thus, of the 60 volunteer patients included in the study, 30 were randomly assigned to the experimental group and 30 to the control group. The study was conducted in the cardiovascular surgery intensive care unit of Van Training and Research Hospital between August 2023 and January 2024 [15, 16].

Randomization

Patients who met the research criteria were randomly divided into experimental and control groups according to the order of admission to surgery using the two-block randomization method on the Random.org website. The group was identified by examining the sequence number in the table. This randomization technique was used until the required sample size was obtained for each group. A single-blind method was used because the patients did not know which group they were in (Fig. 1). The study was conducted in accordance with CONSORT rules.

Instruments

Data were collected using a Descriptive Characteristics Form and the Postoperative Recovery Index (PoRI).

Descriptive characteristics form

The descriptive characteristics form, which was prepared by the researchers by reviewing the literature, consisted

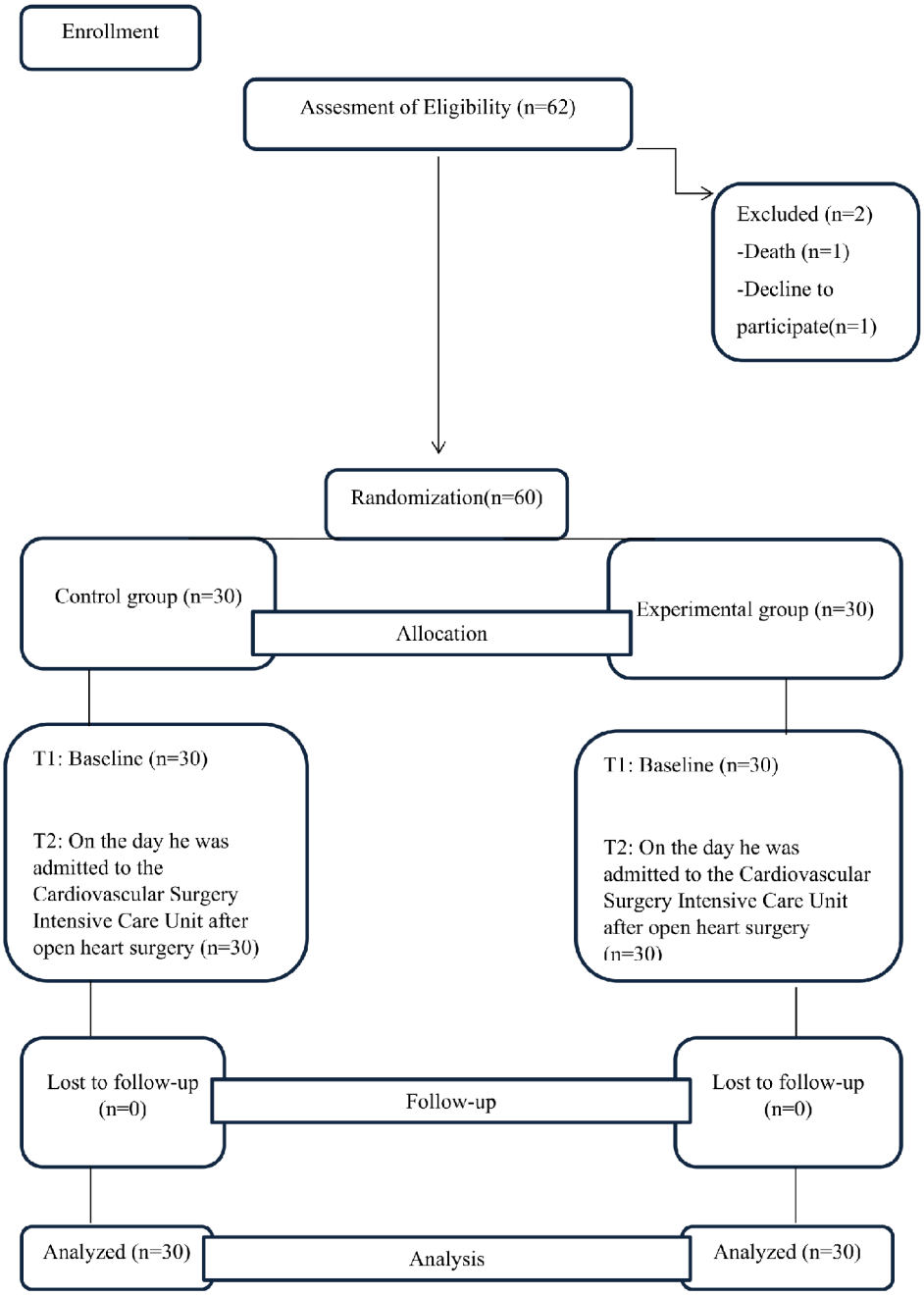

Fig. 1 CONSORT diagram

of questions about the socio-demographic characteristics of the patients (gender, age, educational status, etc.) and questions about the onset time of pain, the number of chest tubes, and the total number of opioids and analgesics used in 24 h to relieve pain. There was also a question on the duration of hospitalization in the descriptive characteristics form.

Postoperative Recovery Index (PoRI)

Cengiz & Aygin conducted the Turkish validity and reliability study of PoRI developed by Butler et al. in 2012. The scale can be used within 30 days after surgery and is suitable for different surgical interventions. The 25-item PoRI has five sub-dimensions: psychological symptoms, physical activities, general symptoms, bowel symptoms, and appetite symptoms. Higher scores on the index reflect more difficulty in postoperative recovery, while lower scores indicate that postoperative recovery is easier. In this study, Cronbach's alpha coefficient was found to be 0.967. The Cronbach alpha coefficients of the subdimensions of the scale vary between 0.93 and 0.983 [17].

Data collection

Approval was obtained from the Ethics Committee of Van Training and Research Hospital before data collection. Before collecting data from the target population, the informed consent form was read to the patients, and their signatures were obtained. During the data collection process, 30 of 60 patients who were hospitalized in the Cardiovascular Surgery Intensive Care Clinic of a hospital and underwent open-heart surgery were included in the experimental group. A total of 2 ampoules of LIDOFAST 40 mg/2 ml + 0.025 mg/2 ml were injected into the sternotomy incision area and around the chest tubes of 30 patients in the experimental group immediately after the operation before the dressings were applied. The total number and dose of opioids, the total number and dose of analgesics used to relieve the pain of the patients in the 24 h after the injection of 2 ampules of LIDOFAST 40 mg/2 ml + 0.025 mg/2 ml, and the total number and dose of analgesics were recorded, and the patients were interviewed face-to-face 24 h later, and PoRI was recorded. No intervention was performed on 30 patients in the control group, and standard treatment and care continued to be applied to these patients.

Van training and research hospital cardiovascular surgery intensive care unit pain treatment protocol

Paracetamol and NSAIDs are important components of multimodal analgesia. Both agents reduce opioid use and side effects. Paracetamol is a commonly used agent because it has fewer side effects. However, its analgesic effect is weaker than NSAIDs. In the hospital where this study was conducted, paracetamol is used first in the pain treatment protocol, followed by NSAIDs and opioids when needed.

LIDOFAST 40 mg/2 ml + 0.025 mg/2 ml

- Each ampoule contains 40 mg lidocaine hydrochloride and 0.025 mg epinephrine base as active substances. Lidocaine belongs to the group of medicines called local anesthetics. LIDOFAST is used in medical applications and surgeries to prevent pain. It provides a different anesthesia by affecting the pain sensation more than fine touch and pressure. Onset of action is < 2 min, with a duration of efficacy of 1–2 h and a maximum dosage of 5 mg/kg. Collins et al. (2013) observed analgesia in the volar forearm before 1 min in a study [18]. In head and neck skin cancer patients, Safran et al. (2019) observed rapid analgesia (≤ 1.0 min) with a smaller LIA volume (≤ 3.0 ml) in the eyebrow, lower eyelid, upper nose, ear lobule, and helix. The vertex scalp (3.0 mm thick) took 1.2 min, while the occipital scalp (8.0 mm thick) took 3.5 min [19]. In this direction, it is seen that the duration of action of LIDOFAST 40 mg/2 ml + 0.025 mg/2 ml varies depending on various factors such as application area, tissue distribution, application volume, and specific tissue properties, but the onset of action is often shorter than 2 min.

Data assesment

Statistical Package for the Social Sciences (SPSS) 19.0 (SPSS Inc., Chicago, Illinois, USA: United States of America) package program was used for data evaluation. Descriptive statistics for continuous variables were expressed as mean and standard deviation, while descriptive statistics for categorical variables were expressed as number and percentage. Normality of data distribution was tested by Kolmogorov-Smirnov, and homogeneity of variances was tested by Levene's test. In independent two-group comparisons in terms of continuous variables, the Independent Groups T-test was used in cases where normal distribution conditions were met, and Mann-Whitney U test statistics were used in cases where normal distribution conditions were not met. In independent comparisons of more than two groups in terms of continuous variables, one-way analysis of variance (ANOVA) was used in cases where normal distribution conditions were met, and Kruskal-Wallis test statistics were used in cases where normal distribution conditions were not met. The Spearman rank correlation coefficient was calculated between groups to determine the relationship between continuous variables. All test data were evaluated at a 95% confidence interval and a 0.05 significance level.

Table 1 Demographic characteristics for experimental and control groups

Features	Experimental Group	Frequency	Percent (%)	Control Group	Frequency	Percent (%)	*p*
Diagnosis	CABG*	23	76.8	CABG	23	76.8	0.252
	MVR**	1	3.3	MVR	5	16.7	
	AVR***	1	3.3	AVR	1	3.3	
	Tricuspid Repair	1	3.3	Tricuspid Repair	1	3.3	
	Abdominal Aortic Aneurysm	3	10				
	Cardiac Mixoma	1	3.3				
Gender	Male	19	63.3	Male	24	80	0.152
	Female	11	36.7	Female	6	20	
Marital Status	Married	29	96.7	Married	30	100	0.313
	Single	1	3.3				
Education Status	Illiterate	11	36.7	Illiterate	8	26.7	0.067
	Literate	13	43.3	Literate	6	20	
	Primary School	2	6.7	Primary School	4	13.3	
	Middle School	2	6.7	Middle School	6	20	
	High School	1	3.3	High School	6	20	
	Undergraduate and Graduate	1	3.3				
Profession	Not working	20	66.7	Not working	18	60	0.784
	Self-employment	3	10	Self-employment	4	13.3	
	Housewife	4	13.3	Housewife	1	3.3	
	Retired	1	3.3	Retired	4	13.3	
	Other	2	6.7	Other	3	10	

*Coronary Artery Bypass Graft (CABG), **Mitral Valve Replacement (MVR), *** Atrial Valve Replacement (AVR)

Ethics approval and consent to participate

Before starting the study, approval was obtained from the Ethics Committee of Van Training and Research Hospital (File Decision No: 2023/19 – 07). Explanations about the voluntary nature of participation were added to the informed consent form. In addition, it was also stated that the personal information of the participants will not be shared with anyone, and care will be taken to comply with the "Privacy and Confidentiality Protection Principle". The "principle of anonymity and security" was fulfilled by keeping the information obtained and the identity of the respondent confidential. The Helsinki Declaration was upheld.

Results

The descriptive characteristics of the patients were analyzed and found that 76.8% of those in the experimental group had open heart surgery with a diagnosis of CABG, 63.3% were men, 96.7% were married, 43.3% could read and write, and 67.7% did not have a job. When the distribution of the descriptive characteristics of the patients in the control group was analyzed, it was determined that 76.8% of the patients had undergone open heart surgery with a diagnosis of CABG, 80% were male, 100% were married, 26.7% were illiterate, and 60% were not employed (Table 1).

When the mean age of the patients was analyzed, it was determined that the mean age of the patients in the experimental group was 55.6 ± 11.35 and the mean age of the patients in the control group was 55.33 ± 4.45. When the length of hospital stay of the patients in the post-op period was analyzed, it was determined that the patients in the experimental group stayed in the hospital for 8.36 ± 3.04 days and the patients in the control group stayed in the hospital for 8.63 ± 4.51 days. The difference between the experimental and control group averages was not statistically significant in terms of both age and length of hospital stay in the post-op period ($p > 0.05$) (Table 2).

Table 2 Descriptive statistics and comparison results

	Group	*n*	Mean ± Std.Deviation	*P*
Age	Control	30	55.33 ± 4.45	0.420
	Experiment	30	55.6 ± 11.35	
Post-op Hospitalization Duration (Days)	Control	30	8.63 ± 4.51	0.578
	Experiment	30	8.36 ± 3.04	

It was determined that 26.7% of the patients in the experimental group started to have pain 10 h after surgery, 76.7% had 2 chest tubes inserted, 53.3% did not use any opioid within 24 h after surgery, 60% used Parol and 76.7% used Ketavel, and 73.3% did not use Dichloron (Table 3). It was determined that 26.7% of the patients in the control group had the onset of pain 6 h after surgery, 63.3% had 2 chest tubes inserted, 56.7% had 2 opioids administered within 24 h after surgery, 100% of

Table 3 Duration of Pain Onset, number of chest tubes, number of opioids, and Analgesics used

Features	Experimental Group	Frequency	Percent (%)	Control Group	Frequency	Percent (%)	*p*
Pain Onset Time (After Surgery: Hours)	3	1	3.3	2	1	3.3	0.060
	4	1	3.3	3	2	6.7	
	6	5	16.7	4	3	10	
	8	6	20	5	3	10	
	10	8	26.7	6	8	26.7	
	12	6	20	7	2	6.7	
	14	3	10	8	7	23.3	
				10	3	10	
				12	1	3.3	
Number of Chest Tubes	2	23	76.7	1	7	23.3	**0.017**
	3	7	23.3	2	19	63.3	
				3	4	13.3	
Number of Opioids Used	0	16	53.3	0	5	16.7	**0.001**
	1	14	46.7	1	2	6.7	
				2	17	56.7	
				3	5	16.7	
				4	1	3.3	
Opioid Dosage (mg)	0	16	53.3	0	5	16.7	**0.001**
	100	14	46.7	100	2	6.7	
				200	17	56.7	
				300	5	16.7	
				400	1	3.3	
Was Parol (paracetamol) used?	Yes	18	60	Yes	30	100	**0.001**
	No	12	40				
Paracetamol Dose Administered (mg)	100	18	60	100	8	26.7	**0.001**
				200	14	46.7	
				300	6	20	
				400	2	6.7	
Was Ketavel (dexketoprofen, trometamol) used?	Yes	23	76.7	Yes	20	66.7	0.390
	No	7	23.3	No	10	33.3	
Administered dose of Ketavel (dexketoprofen, trometamol) (mg)	50	16	53.3	50	7	23.3	0.055
	100	7	23.3	100	9	30	
				150	1	3.3	
				200	3	10	
Was dichloron (diclofenac sodium) used?	Yes	8	26.7	Yes	10	33.3	0.573
	No	22	73.3	No	20	66.7	
Administered Dichloron (Diclofenac sodium) Dose (mg)	100	8	26.7	100	8	26.7	0.180
				200	2	6.7	

the patients received Parol, 66.7% received Ketavel, and 66.7% did not receive Dichloron (Table 3).

When the PoRI and its sub-dimensions given in Table 4 were analyzed, the difference between the experimental and control group averages was statistically significant ($p < 0.05$). Accordingly, the scores of the experimental group were found to be significantly lower than the control group in all comparisons, and it was found that postoperative recovery was faster in the experimental group (Table 4).

In the comparison of PoRI and sub-dimensions of disease diagnoses in open heart surgery, no statistically significant difference was found between the mean scores of the experimental group, whereas the control group of patients undergoing valve surgery had a higher desire symptoms sub-score, and it was found that postoperative recovery took longer in this sub-dimension ($p < 0.05$) (Table 6).

In the comparison of the number of chest tubes and PoRI and its sub-dimensions, no significant difference was found between the number of chest tubes and psychological symptoms, physical activities, appetite symptoms, general symptoms sub-dimensions, and total PoRI scores of the patients in the control group, whereas a

Table 4 Comparison of PoRI and its Subscales in the experimental and control groups

	Groups	*n*	Mean ± Std. Deviation	*p*
Psychological Symptoms	Control	30	3.53 ± 0.57	**0.001**
	Experiment	30	2.28 ± 0.50	
Physical Activities	Control	30	4.22 ± 0.91	**0.020**
	Experiment	30	4.00 ± 0.56	
Appetite Symptoms	Control	30	3.33 ± 0.99	**0.001**
	Experiment	30	1.93 ± 0.56	
Bowel Symptoms	Control	30	3.09 ± 1.03	**0.001**
	Experiment	30	1.63 ± 0.49	
General Symptoms	Control	30	3.32 ± 0.88	**0.001**
	Experiment	30	2.20 ± 0.65	
Total	Control	30	3.60 ± 0.68	**0.001**
	Experiment	30	2.63 ± 0.37	

Table 5 Correlation between length of hospitalization in the post-op period and PoRI scores

	Groups	PoRI scores
Length of Hospitalization in the Post-Op Period	Control Group	$r = 0.432$* (***p* = 0.017**)
	Experimental Group	$r = 0.155$ ($p = 0.412$)

*Correlation is significant at the 0.05 level (2-tailed).While the correlation between the length of stay and total scale score of the patients in the control group was statistically significant, the correlation between the decreased length of stay due to the effect of local anesthetic agents applied to the patients in the experimental group and the total scale score was found to be insignificant ($p > 0.005$) (Table 5)

statistically significant difference was found between the number of chest tubes and the mean intestinal symptoms sub-dimension ($p < 0.05$). It was found that the PoRI score increased as the number of chest tubes increased, and postoperative bowel symptom improvement was negatively affected. In the experimental group, a statistically significant difference was found between the number of chest tubes and the general symptoms subscale ($p < 0.05$). It was found that the PoRI score increased as the number of chest tubes increased, and the improvement in the postoperative general symptoms subscale was negatively affected (Table 7).

When the number of opioids administered to the control group was compared with the PoRI and its sub-dimensions, no significant difference was found between the number of opioids administered to the control group and the sub-dimensions of psychological symptoms, appetite symptoms, bowel symptoms, and general symptoms, whereas a significant difference was found between the number of opioids administered to the control group and the sub-dimension of physical activities and total PoRI ($p < 0.05$). It was found that as the number of opioids used increased, postoperative recovery and physical activity subscales were negatively affected. No significant difference was found between the experimental group and PoRI and its sub-dimensions ($p > 0.05$) (Table 8).

Table 6 Comparison of PoRI and Subscale scores of Disease diagnoses

GROUPS			*n*	Mean ± Std. Deviation	*p*
CONTROL GROUP	Total	Bypass Surgery	23	3.56 ± 0.59	
		Valve Surgery	3	3.92 ± 0.93	0.716
		Other	4	3.57 ± 1.13	
	Appetite Symptoms	Bypass Surgery	23	3.10 ± 0.87	
		Valve Surgery	3	4.50 ± 0.66	**0.045**
		Other	4	3.75 ± 1.32	
	Bowel Symptoms	Bypass Surgery	23	3.13 ± 0.91	
		Valve Surgery	3	2.73 ± 2.05	0.824
		Other	4	3.10 ± 1.10	
	General Symptoms	Bypass Surgery	23	3.17 ± 0.88	
		Valve Surgery	3	4.16 ± 0.76	0.163
		Other	4	3.56 ± 0.77	
	Psychological Symptoms	Bypass Surgery	23	3.59 ± 0.53	
		Valve Surgery	3	3.50 ± 0.90	0.437
		Other	4	3.18 ± 0.62	
	Physical Activities	Bypass Surgery	23	4.24 ± 0.69	
		Valve Surgery	3	4.45 ± 0.83	0.782
		Other	4	3.96 ± 1.98	
EXPERİMENTAL GROUP	Total	Bypass Surgery	23	2.61 ± 0.41	0.632
		Valve Surgery	7	2.69 ± 0.20	
	Appetite Symptoms	Bypass Surgery	23	1.92 ± 0.64	0.872
		Valve Surgery	7	1.96 ± 0.09	
	Bowel Symptoms	Bypass Surgery	23	1.56 ± 0.50	0.172
		Valve Surgery	7	1.85 ± 0.37	
	General Symptoms	Bypass Surgery	23	2.20 ± 0.68	0.924
		Valve Surgery	7	2.17 ± 0.60	
	Psychological Symptoms	Bypass Surgery	23	2.23 ± 0.51	0.392
		Valve Surgery	7	2.42 ± 0.44	
	Physical Activities	Bypass Surgery	23	4.01 ± 0.62	0.892
		Valve Surgery	7	3.98 ± 0.37	

Discussion

A multimodal approach to pain management should be used to optimize analgesia and minimize opioid side effects. For surgical patients, local anesthetics are an important component of a multimodal analgesic regimen [20]. In this study, it was found that 26.7% of the patients in the experimental group started to have pain 10 h after surgery, while 26.7% of the patients in the control group started to have pain 6 h after surgery. In Yeşildal's study to compare the effects of different concentrations of Lidocaine administered as skin infiltration on pain and hemodynamic response in patients who underwent surgery for pituitary adenoma and received a spiked cap, 0.5% Lidocaine was administered to 36 patients, and 1% Lidocaine was administered 3 ml subcutaneously to the points where the nails penetrated the skin in 36 patients.

Table 7 Comparison of PoRI and sub-dimensions of the number of chest tubes

GROUPS		Number of Chest Tubes	*n*	Mean ± Std. Deviation	*P*
CONTROL GROUP	Total	1.00	7	3.26 ± 1.11	0.069
		2.00	19	3.58 ± 0.39	
		3.00	4	4.25 ± 0.56	
	Appetite Symptoms	1.00	7	3.42 ± 1.46	0.450
		2.00	19	3.18 ± 0.78	
		3.00	4	3.87 ± 1.03	
	Bowel Symptoms	1.00	7	2.48 ± 0.91	**0.038**
		2.00	19	3.10 ± 0.97	
		3.00	4	4.10 ± 0.84	
	General Symptoms	1.00	7	3.32 ± 1.17	0.193
		2.00	19	3.17 ± 0.74	
		3.00	4	4.06 ± 0.82	
	Psychological Symptoms	1.00	7	3.28 ± 0.74	0.144
		2.00	19	3.52 ± 0.50	
		3.00	4	4.00 ± 0.40	
	Physical Activities	1.00	7	3.64 ± 1.62	0.105
		2.00	19	4.33 ± 0.48	
		3.00	4	4.75 ± 0.30	
EXPERİMENTAL GROUP	Total	2.00	23	2.59 ± 0.34	0.284
		3.00	7	2.77 ± 0.47	
	Appetite Symptoms	2.00	23	1.89 ± 0.42	0.469
		3.00	7	2.07 ± 0.92	
	Bowel Symptoms	2.00	23	1.69 ± 0.47	0.212
		3.00	7	1.42 ± 0.53	
	General Symptoms	2.00	23	2.05 ± 0.57	**0.025**
		3.00	7	2.67 ± 0.71	
	Psychological Symptoms	2.00	23	2.21 ± 0.46	0.198
		3.00	7	2.50 ± 0.59	
	Physical Activities	2.00	23	3.96 ± 0.59	0.484
		3.00	7	4.14 ± 0.50	

Table 8 Comparison of the number of opioids with PoRI and its Subscales

GROUPS		Opioid count	*n*	Mean ± Std. Deviation	*P*
CONTROL GROUP	Total	0.00	5	2.75 ± 0.91	**0.027**
		1.00	2	3.46 ± 1.49	
		2.00	17	3.80 ± 0.41	
		3.00	5	3.70 ± 0.41	
		4.00	1	4.16±.	
	Appetite Symptoms	0.00	5	2.25 ± 0.55	0.097
		1.00	2	3.12 ± 1.94	
		2.00	17	3.54 ± 0.88	
		3.00	5	3.70 ± 0.97	
		4.00	1	3.75±.	
	Bowel Symptoms	0.00	5	2.20 ± 0.83	0.196
		1.00	2	2.70 ± 2.40	
		2.00	17	3.36 ± 0.91	
		3.00	5	3.04 ± 0.76	
		4.00	1	4.00±.	
	General Symptoms	0.00	5	2.90 ± 1.02	0.701
		1.00	2	3.12 ± 1.59	
		2.00	17	3.52 ± 0.87	
		3.00	5	3.15 ± 0.74	
		4.00	1	3.25±.	
	Psychological Symptoms	0.00	5	3.10 ± 0.65	0.315
		1.00	2	3.50 ± 0.70	
		2.00	17	3.57 ± 0.54	
		3.00	5	3.70 ± 0.54	
		4.00	1	4.25±.	
	Physical Activities	0.00	5	3.10 ± 1.63	**0.035**
		1.00	2	4.25 ± 1.06	
		2.00	17	4.47 ± 0.43	
		3.00	5	4.40 ± 0.57	
		4.00	1	4.87±.	
EXPERİMENTAL GROUP	Total	0.00	16	2.62 ± 0.33	0.867
		1.00	14	2.64 ± 0.42	
	Appetite Symptoms	0.00	16	1.85 ± 0.38	0.453
		1.00	14	2.01 ± 0.72	
	Bowel Symptoms	0.00	16	1.56 ± 0.51	0.407
		1.00	14	1.71 ± 0.46	
	General Symptoms	0.00	16	2.06 ± 0.60	0.227
		1.00	14	2.35 ± 0.70	
	Psychological Symptoms	0.00	16	2.39 ± 0.59	0.218
		1.00	14	2.16 ± 0.34	
	Physical Activities	0.00	16	4.07 ± 0.49	0.533
		1.00	14	3.93 ± 0.65	

Pain values were found to be lower in the group administered 1% Lidocaine at 30 min and 1 h postoperatively compared to the group administered 0.5% Lidocaine [15]. In a study conducted by Dowling et al. to investigate the postoperative pain levels and narcotic requirements of continuous regional local anesthetic injection into the sternotomy incision area in patients undergoing open heart surgery, pain scores in the experimental group using Ropivacaine were significantly lower than in the control group [21]. Recent studies support the results of this study and conclude that the application of local anesthetic agents to the incision site and around the chest tubes reduces the level of pain in the postoperative period and thus prolongs the onset time of pain.

In this study, it was found that 53.3% of the patients in the experimental group did not receive any opioids within 24 h after surgery, while 56.7% of the patients in the control group received opioids twice within 24 h after surgery. An investigation by White et al. looked at how local anesthetic infusion could help with pain after median sternotomy. They found that the group that used 0.5% Bupivacaine used less Morphine in the days after surgery, which was statistically significant [22]. In a study by Dowling et al. investigating the postoperative pain levels and narcotic requirements of local anesthetic injection applied to the sternotomy incision area in patients

undergoing open heart surgery, the amount of postoperative narcotic analgesia required by the group using Ropivacaine was found to be significantly lower than the control group [21]. Recent studies support the results of this study and suggest that the application of local anesthetic agents around the incision site or chest tube reduces postoperative opioid consumption.

In this study, the correlation between the duration of postoperative hospital stay and the total scale score of the patients in the control group was statistically significant, whereas it was not significant in the experimental group. Thanks to the local anesthetic applied, it was determined that the patients in the experimental group stayed in the hospital for a shorter time. Koç did a study in 2011 to compare the effectiveness and side effects of epidural patient-controlled analgesia and multimodal analgesia after a total abdominal hysterectomy. The first group got an epidural block, and the second group got 0.25% Bupivacaine 20 ml injected into the wound along the surgical incision line at the end of the surgery. No significant difference was found between the two groups in terms of discharge time [16]. White et al. looked into how local anesthetic infusion could help with pain after median sternotomy. They found that the group that received 0.5% Bupivacaine had a shorter hospital stay than the control group [22]. In the study of Dowling et al. the duration of postoperative hospitalization in the experimental group using ropivacaine was found to be shorter than in the control group [21]. When the results of this study are evaluated, it is thought that the patient group, the surgical intervention, the type of local anesthetic agent, and the dose of administration may have different effects on the duration of postoperative hospitalization.

At the same time, when PoRI and its sub-dimensions were examined in this study, it was found that the difference between the experimental and control group averages was statistically significant, and the scores of the experimental group were significantly lower than the control group in all comparisons. Based on this result, it was determined that local anesthetic agents applied to the sternotomy incision site and around the chest tubes had a positive effect on the improvement of psychological symptoms, physical activities, appetite, bowel and general symptoms of the patients in the postoperative period.

Methods used to manage pain after open heart surgery may prevent the recovery of bowel and bladder function in the postoperative period [22]. In this study, it was found that the PoRI score of the patients in the control group increased as the number of chest tubes increased, and the improvement in postoperative bowel symptoms was negatively affected. In the experimental group, it was found that the PoRI score increased as the number of chest tubes increased, and recovery was negatively affected in the postoperative general symptoms subscale. In Koç's study of patients who had a total abdominal hysterectomy, there was no significant difference between the groups where 0.25% Bupivacaine 20 ml was applied to the surgical incision line and those where an epidural block was applied in terms of the time it took to move around and hear bowel sounds for the first time. However, the time it took to go to the bathroom for the first time was significantly shorter in the group that had an epidural block [16]. Similar studies on open heart surgery have not been found in the literature, and it is thought that the type of surgical intervention, type, and amount of local anesthetic agent used have different effects on the results.

Conclusion

Following this study, it is suggested that a local anesthetic called LIDOFAST 40 mg/2 ml + 0.025 mg/2 ml be applied to the area of the sternotomy incision and around the chest tubes. This will help patients who are having open heart surgery heal faster and use fewer opioids after the surgery. Also, while there are studies that look at how local anesthetics affect pain levels and opioid use after surgery, none were found that used a local anesthetic to be injected into the sternotomy incision area and around the chest tubes, which are the most painful parts of open heart surgery. Correct management of pain, particularly in the first 24 h after open heart surgery, is crucial for patient care. Nurses caring for patients, especially in intensive care units, should have information about the effects on the patient by following the effects and side effects of the drugs applied to relieve pain. The knowledge of nurses in pain management plays a crucial role in the patient care process and constitutes the core of quality care. The results of the study will guide all clinicians and health professionals in the patient care process. It is thought that there is a serious gap in the literature on this issue, and it is recommended to fill the gaps in the literature by increasing the supporting studies on this issue.

Practice implications

Open heart surgery is a major surgical procedure, and patients may experience high-intensity pain postoperatively due to the sternotomy incision and chest tubes. Pharmacologically, opioids and non-opioid analgesics are used for pain relief. However, evidence-based guidelines indicate that opioids, while providing analgesic effects, have many side effects, such as respiratory depression, euphoria, vasodilation, bradycardia, miosis, nausea and vomiting, and physical dependence. In addition, due to the side effects of the opioid drugs used in the studies, the prescription of the drugs by the doctor and their administration by the nurse creates uneasiness. For this reason, the use of these drugs should be very

careful in the postoperative period. Different pain relief methods used in the postoperative period may be preferred instead of opioids. Local anesthetic agents applied to painful areas after surgery are effective pain relief methods and reduce the need for opioid use in patients. These results support the effective use of LIDOFAST 40 mg/2 ml + 0.025 mg/2 ml by physicians and nurses in pain management, reducing opioid consumption and recovery after open heart surgery.

Limitations

This study was limited to patients who were hospitalized in the cardiovascular surgery intensive care unit of a hospital, underwent open heart surgery, met the sample selection criteria, and agreed to participate in the study. Since the study was conducted in a single center and the number of patients was limited, the results of the study cannot be generalized to all patients.

The strengths of this study include the use of a randomized, controlled experimental design and the application of validated and reliable scales. The number of opioids used for postoperative pain relief and the evaluation of postoperative recovery were obtained using SPSS with statistical counseling.

Abbreviations

PoRI	Postoperative Recovery Index
SPSS	Statistical Package for the Social Sciences
USA	United States of America
CABG	Coronary Artery Bypass Graft
MVR	Mitral Valve Replacement
AVR	Atrial Valve Replacement

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Author contributions

The contribution(s) of the author(s) to the submitted manuscript were created using the CRediT Taxonomy as follows: HA: Conceptualization, Formal analysis, Investigation, Methodology, Resources, Software, Auditing, Validation, Visualization, Writing - original draft, Writing - review and editingMA: Investigation, Data curation, ValidationZG: Validation, Visualization, Data curation, Writing - review and editing YB: Investigation, Data collectionCD: Formal Analysis, Investigation.

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Data availability

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Before starting the study, approval was obtained from the Ethics Committee of Van Training and Research Hospital (File Decision No: 2023/19 – 07). Explanations about the voluntary nature of participation were added to the informed consent form. In addition, it was also stated that the personal information of the participants will not be shared with anyone, and care will be taken to comply with the "Privacy and Confidentiality Protection Principle". The "principle of anonymity and security" was fulfilled by keeping the information obtained and the identity of the respondent confidential. The Helsinki Declaration was upheld.

Consent for publication

Explanations were added to the questionnaire form and informed consent form for the participants, indicating that participation was voluntary and written informed consent was obtained from the participants.

Competing interests

The authors declare no competing interests.

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